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IONIZATION CHAMBER for CARBON-14 MEASUREMENTS

by

C. J. Borkowski

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Technical Information Division, Oak Ridge Directed Operations

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Measuring C^{14} as $C^{14}O_2$ in an ionization chamber has the following advantages:

1) A constant reproducible geometry is always obtained.
2) There are no self-absorption corrections to apply.
3) Increased sensitivity over solid sample counting is obtained. Intensities from one disintegration per second to 10^6 disintegrations per second can be measured.
4) Up to 1000 ml of CO_2 can be measured. This is equivalent to approximately 8 g $BaCO_3$.
5) The time required to acidify a sample of $BaCO_3$ and introduce it into an ionization chamber takes no longer than to spread properly an infinitely thick solid sample for G-M counting.

The purpose of this report is primarily to release a design on an ionization chamber, thirty of which have been used for routine C^{14} and H^3 measurement. The ionization currents in all cases were measured with a dynamic condenser electrometer, although a Lindemann electrometer connected to this type of chamber could also be used.

In the measuring of ionization currents of the order of 10^{-15} to 10^{-16} amperes, insulator currents due to stresses in the insulator begin to manifest themselves. In order to minimize these insulator currents, the collecting electrode insulator volume should be kept to a minimum, and the insulator itself should be shielded both from the high voltage electrode and any external fields which might induce charges on the insulator surface when the chamber is removed from the electrometer.

The insulator current due to stresses on the insulator when the chamber is evacuated is less than -10^{-16} amperes.

The background of the chamber filled with dead CO_2 and shielded by 2 inches of lead is 1.5×10^{-16} amperes. About one-half of this background is due to alpha particles present as natural radioactive contamination in the brass.

One disintegration per second of C^{14} in a chamber of this type having a volume of 300 ml gives a current of about 1×10^{-16} amperes, when the diluent gas is dead CO_2 and is at one atmosphere pressure.

The insulator for the collecting electrode may be purchased from the American Phenolic Corp., Chicago, Illinois.

A complete report describing the use of this chamber and associated techniques in acidification of $BaCO_3$ and combustion techniques will be published shortly by C. J. Borkowski and W. Leslie.

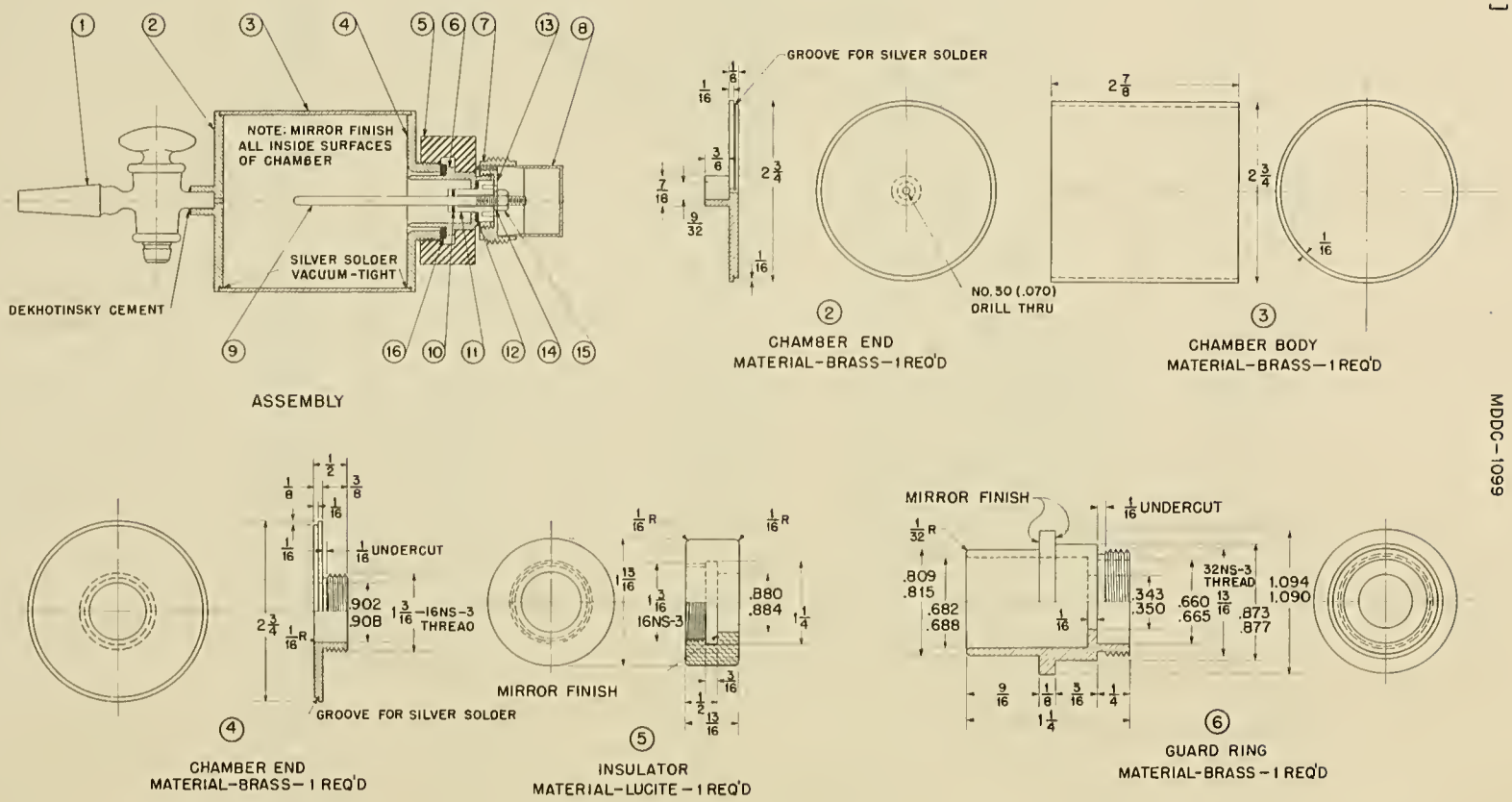
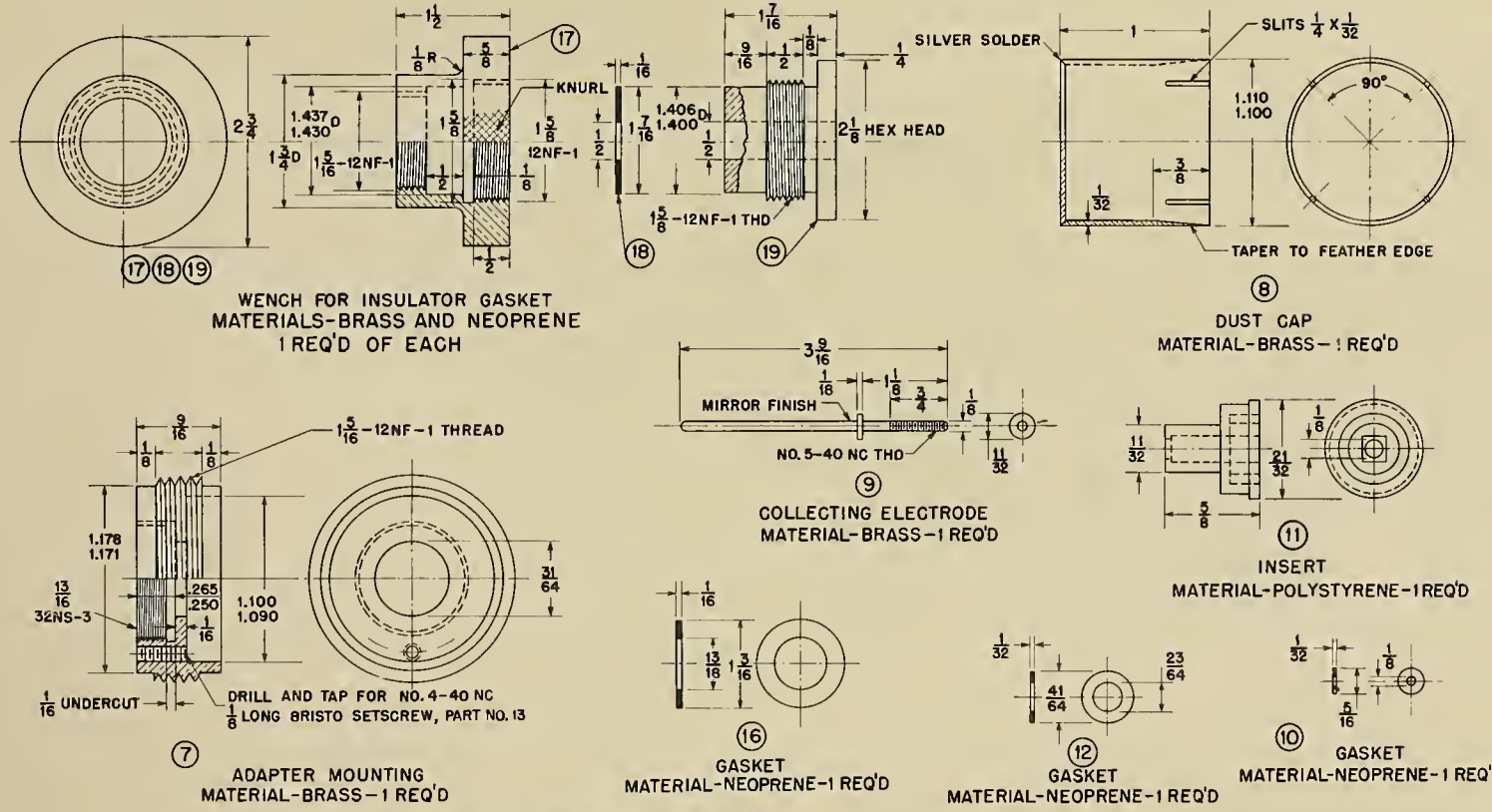


Figure 1. Gas ionization chamber.



NOTE: DIMENSIONS ARE IN INCHES
TOLERANCE: DECIMAL ±.005—FRACTIONAL ±1/64
(UNLESS OTHERWISE SPECIFIED)

Figure 1. (continued)

BILL OF MATERIAL

Part	Required	Description	Material
1	1	Stopcock-12/30-straight bore	Pyrex
2	1	Chamber end	Brass
3	1	Chamber body	Brass
4	1	Chamber end	Brass
5	1	Insulator	Lucite
6	1	Guard ring	Brass
7	1	Adapter mounting	Brass
8	1	Dust cap	Brass
9	1	Collecting electrode	Brass
10	1	Gasket	Neoprene
11	1	Insert	Polystyrene
12	1	Gasket	Neoprene
13	1	No. 4-40NC Bristo setscrew 1/8'' L	Steel
14	1	1/8'' Flat washer	Brass
15	1	No. 5-40NC hex nut	Brass
16	1	Gasket	Neoprene
17	1	Wrench ring	Brass
18	1	Washer	Neoprene
19	1	Plug	Brass